

**REMARKS**

Entry of the foregoing and reconsideration of the application identified in caption as amended, pursuant to and consistent with the Rules of Practice in Patent Cases, and in light of the remarks which follow, is respectfully requested.

By the present amendment claims 1, 2, 6, and 12 have been amended and new claim 14 has been presented so that claims 1-12 and 14 will be pending upon entry of the present amendment.

Claim 2 stands objected to with respect to apparent substituents of  $R^K$ . Claim 2 has been amended to more particularly point out that the sulfonate, phosphonate, and carboxylate substituents relate to the variable L and not to the variable  $R^K$ .

Claim 6 stands objected to with respect to the use of the word "equalized," the Examiner suggests the word be changed to "neutralized." Applicants have amended claims 1, 6, and 12 to replace the word "equalized" with the word "neutralized" in accordance with the Examiner's request.

Accordingly, withdrawal of the record objections to the claims is respectfully requested.

Claims 1-12, now represented by claims 1-12 and 14, stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,064,877 to Nass et al. ("Nass"). This rejection is respectfully traversed.

Nass discloses a process for the preparation of an organic polymer matrix in which an inorganic poly-condensate structure is anchored (column 8, lines 43 to 47). These polymers are prepared by reacting a compound of Formula (I)  $MR_n$  with an organic compound A followed by polymerization or polycondensation of the reaction product in the presence of water (column 1, line 66 to column 2, line 19). M is a metal and R is a radical which can be replaced by a complexing agent (column 2, lines 1 to 7). The reaction is said to proceed in two steps, firstly, compound A replaces one or more of radicals R. Secondly, water is added to replace all remaining R residues by hydroxyl groups, which are then subjected to a condensation reaction (column 6, line 58 to column 7, line 27).

According to Nass  $MR_4$  and organic compound A can be employed in different molar ratios (column 6, line 58 and column 7, line 34). When used in a molar ratio of 1:1 a three-dimensional network is said to form (column 6, line 58 to column 7, line 12) whereas as ratio of 1:2 is said to give metal oxide fibers (column 7, lines 28 to 31). If the

ratio between  $MR_n$  and A is reduced further shorter chains are obtained (column 7, lines 32 to 34). It is important to note that at a ratio of 1:4 M fully is complexed by A which prevents hydrolysis and condensation (column 7, lines 33 to 35). In this instance, A replaces all residues R on the central metal atom M. Consequently, a ratio of 1:0.5 to 1:3 is preferred (column 7, lines 36 to 45). At such ratios of  $MR_n$  to A no clusters according to Formula (I) of the present invention are formed.

In contrast, according to the present invention the clusters of Formula (I) are prepared by reacting, e.g., metal alkoxides with a high molar excess of methacrylic acids under conditions which result in the formation of clusters such as  $Zr_4O_2(OMc)_{12}$ . According to page 7, last paragraph of the present specification, a quadruple molar excess of methacrylic acid is used and according to Kickelbick et al., referred to at page 7, methacrylic acid is used in an excess of up to 15-fold. Conversion is achieved by reacting the compound at room temperature for 1 day to 7 days.

According to Nass the educts are reacted for minutes only. Thus, Nass use different ratios and different reaction conditions and consequently obtain different products. The reactions disclosed by Nass do not result in the formation of clusters having a defined structure. To the contrary, use of a ratio of 1:4 is said to give products which do not further condensate, i.e. do not form clusters.

To better distinguish the presently claimed clusters over the teachings of Nass the range of variable (a) in claim 1 has been changed from 1 to 20 to a range of 2 to 20. Support for the lower value of the range of  $a = 2$  can be found in the specification at least at page 6, line 9. By this amendment the claims are restricted to clusters having at least two metal atoms. As discussed above, Nass teach the formation of compounds having only a single metal atom if compound  $MR_4$  and organic compound A are used in a ratio of 1:4.

Accordingly, claims 1-12 and 14 are not anticipated or obvious over the teachings of Nass for at least the reasons noted above. Withdrawal of the record rejection and allowance of the pending claims is respectfully requested.

Claims 1, 4, and 6-12, now represented by claims 1, 4, 6-12 and 14, stand rejected under 35 U.S.C. § 102(a) as being anticipated by WO 00/69392 to Furman et al. ("Furman"). This rejection is respectfully traversed.

Furman discloses dental materials including metal oxide particles having a relatively large particle diameter of at least 10 nm, preferably at least 50 nm (page 6, lines 13 to 15). These particles are obtained by hydrolysis of zirconium alkoxide followed by surface

treatment of the oxide particles (page 4, line 30 to page 5, line 11). For surface treatment the particles are organofunctionalized with an organofunctional coupling agent which preferably include polymerizable groups (page 6, line 20 to page 7, line 2). The particles are then reacted with an adhesion promoter (page 12, line 19 to page 13, line 2) which includes organic residues which may interact with the matrix material but which do not chemically react therewith (page 13, lines 7 to 8).

Surface treatment can be achieved by using aluminozirconates having the formula shown at page 8. These agents condense with the surface of the metal oxide clusters (page 6, lines 22 to 23), i.e. react with -OH groups present at the surface of the oxide particles. In contrast to the Examiner's position, these compounds do not include coordinating groups with complexing capabilities.

It follows that the oxide particles of Furman are covered by an organofunctional coupling agent which may contain polymerizable groups and an adhesion promoter which does not include polymerizable groups. In contrast, the clusters according to Formula (I) of the present invention do not contain coupling agents or adhesion promoters without polymerizable groups and are therefore not anticipated or rendered obvious by the oxide particles of Furman. The clusters of the present invention contain 2 to 30 residues (L-Sp-Z) wherein Z is a polymerizable group.

The present invention is directed to dental materials including clusters according to Formula (I) as set forth in claim 1. These dental materials have improved mechanical properties. The inventors demonstrated that the addition of clusters according to Formula (I) to dental materials resulted in improved bending strength and bending E-modulus. It is important to note that even after storage in water a high E-modulus was found whereas the E-modulus of common materials was significantly lowered by water storage (page 35, last paragraph to page 36, line 2 of the specification). Resistance to water storage is of particular importance for dental materials. The improvement of the mechanical properties of the material is caused by the fact that the clusters of Formula (I) are compact structures which result in the formation of rigid products with a high cross-linking density upon polymerization.

The clusters represent three-dimensional molecules with a defined structure and size which ensures complete incorporation of the clusters into the polymer network. Furthermore, the structure of the clusters provides a uniform environment for all polymerizable organic ligands, so that the ligands are fully equivalent with regard to the

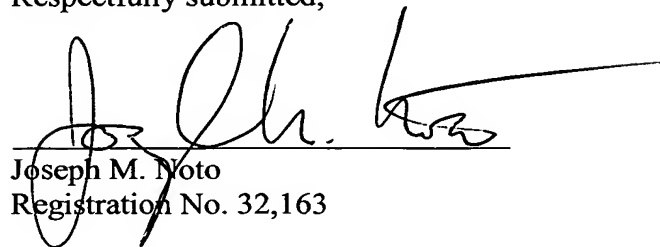
reaction with organic co-monomers. This ensures a uniform polymer structure developing around each ligand (page 10, second paragraph of the specification) and complete incorporation of monomers into the polymer network. The inventors demonstrated that the use of the present clusters results in complete incorporation of polymerizable components into the polymer network of the composite matrix with the effect that no monomeric compounds are washed out from the matrix (page 36, second paragraph of the specification). This is a further significant advantage under physiological aspects since monomers are potentially toxic.

In contrast, the oxide particles of Furman are coated with two different agents, an organic functional coupling agent which may include polymerizable groups and an adhesion promotor which does not contain polymerizable groups. It is evident that these particles do not provide a uniform environment for the polymerizable residues of the coupling agent and are therefore less suitable for the preparation of dental material since they will not give uniform mechanical properties and because these oxide particles cannot ensure complete binding of monomers. For at least the reasons noted above, it was not obvious from or disclosed by the prior art that the above advantages could be achieved by the use of clusters according to claim 1 for the preparation of dental materials.

Accordingly, claims 1, 4, 6-12 and 14 are not anticipated or obvious over the teachings of Furman for at least the reasons noted above. Withdrawal of the record rejection and allowance of the pending claims is respectfully requested.

In view of all of the foregoing, applicant submits that this case is in condition for allowance and such allowance is earnestly solicited.

Respectfully submitted,

  
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